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The impact of trade and technology on the skill profile in Brazil and the Republic of Korea

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1. Introduction

The rapid growth of international trade, international investment and rapid technological upgrading/transfers in manufacturing have led to the emergence of new centres of production and influenced the location of global production. This is best exemplified by the late industrialized countries (LICs) of East Asia and Latin America, which in the 1970s and 1980s significantly expanded their share in the world production and export of manufactured goods. In 1990, 34 per cent of the GDP of East and Southeast Asia was in the manufacturing sector, compared to 26 per cent for Latin America, and 11 per cent for sub-Saharan Africa. The manufacturing sector's share of GDP in some LICs was similar to that of Japan (29 per cent) as in Singapore and Republic of Korea (29 per cent), and even higher for Taiwan, China (36 per cent). Moreover, the role played by these countries in the global division of labour has changed dramatically since the late 1970s. They have moved away from manual assembly to machine production, from low value-added, labour-intensive products to higher value-added and skill-intensive products using cutting-edge technology. This shift required the replacement of specialised manual skills by a broad, generically skilled labour force, and has contributed to a shift in the distribution of skills and/or demand for labour.

According to conventional wisdom, greater openness to trade in developing countries boosts the relative demand for the abundant factor - unskilled labour - due to the expansion of export sectors, and reduces the demand for the scarce factor - skilled labour - due to the contraction of import-competing sectors. Therefore, the Heckscher-Ohlin theory asserts that trade tends to narrow the wage gap between skilled and unskilled workers in developing countries.

However, the opening of developing country economies and the increase in imports have at least two important impacts on the productive system and "contradictory" effects. First, the increase in foreign competition induces technological innovations and greater productivity. Secondly, the opening of the economy promotes the integration of developing country's economies to the world economy. The productive integration to the global economy is seen as an important step towards technological upgrading. These two effects have major impacts on the demand for labour in the manufacturing sector. Both effects tend to create a bias in favour of the demand for skilled labour. Whereas technological upgrading increases the demand for skilled workers in all sectors, the increased openness to trade in developing countries tends to raise the weight of sectors which are intensive in less skilled workers. The aggregate effect of these two forces on the employment structure is however unclear.

This article will study precisely the "paradoxical" effects of increased trade liberalization in **the manufacturing sector** of Brazil and the Republic of Korea. It is expected that, in these countries, changes in occupations and skills in the manufacturing sector will occur in branches or industries subject to intense international competition, either because there is a large penetration of imports, thus greater pressures to compete with foreign producers in the domestic market, or because a large proportion of output is exported, hence having to compete

with international producers abroad. It is also expected that these changes in the employment structure will be biased towards **skilled labour** in the sense that increased international competition stimulates technological upgrading and greater productivity.

These two effects support the central hypothesis of the study, i.e. **that the adoption of new technologies and improvements in the skill composition of the labour force would be primarily observed in industries exposed to foreign competition** (Galhardi, 1998). Therefore, liberalized trade in developing countries will induce improvements in production process and qualification of the labour force in both **export and import-competing sectors**.

The article reviews, in the next section, major structural changes, e.g. the level and composition of output, trade and trends in labour productivity and employment in the manufacturing sector in both countries. It will contrast the communalities and divergencies encountered in both cases. This comparison is important for substantiating the final discussion on policy implications. The trends in output, trade and employment will be analysed by sectors classified according to market-orientation[1], production technology, factor intensity, etc. In order to identify the level of exposure of domestic industries to international competition, their export performance and degree of exposure of domestic markets to import penetration will be analysed. Export penetration will be measured by export coefficient (export/total domestic output), and the degree of exposure to import penetration by the import coefficient (import/total demand). A decomposition of changes in employment according to changes in apparent consumption (domestic demand), international trade and labour productivity will be also used to show the impacts of trade liberalization through the assessment of significant change in the import and export coefficients respectively. Section three deals with changes in the occupational structure and skill composition of labour in the manufacturing sector in the selected countries, and relate them to changes in technology and trade regime. In this section, changes in the skill composition of the manufacturing sector will be investigated by using several skill proxies, e.g. non-production workers share in total employment, educational attainment, and /or the number of scientists and engineers (S&E) in view of the availability of data in the countries concerned. Whenever possible more than one variable will be used and compared in order to compensate their intrinsic limitations. Finally, the article provides some thoughts on the linkage between skill and trade in the process of economic integration and their policy implications for LICs facing increased competitiveness from abroad.

2. Major structural changes

In this section, the evidence gathered from the countries surveyed on the level and composition of manufacturing output, trade and employment will be analysed in view of the opening of these economies. In Brazil, and in contrast with the Republic of Korea[2], this process has started only recently. The opening of the economy since 1990 and the launch of

[1] e.g. export-oriented, import-competing and domestically-oriented sectors.

[2] The import liberalization programme was defined in 1967 when South Korea joined the GATT. In 1978, the Committee on Import Liberalization Measures was created and presided by the Ministry of Commerce and Industry. The Committee would meet periodically to decide on the list of products which would be allowed for import without quantitative restrictions.

the stabilization plan in 1994 have promoted important changes in output, labour productivity and trade that have negatively affected employment. **Manufacturing output** increased about 10 per cent during 1990-1995 whereas manufacturing employment fell about 20 per cent in the same period. Labour productivity has increased on average 30.7 per cent and in all manufacturing sectors. The fall in **manufacturing employment** took place at the same time the share of services in total employment was increasing. In fact, the share of manufacturing in total employment fell from 23 per cent in 1990 to 18 per cent in 1996 and that of services increased from 46 per cent to 50 per cent over the same period. Important changes have also occurred in the **trade pattern** of the manufacturing sector, specially after 1994, when the opening process was deepened and the real exchange rate appreciated providing an enormous stimulus to imports. This had an important direct impact on the **trade balance** of the manufacturing sectors. As seen on Figure 1, whereas the coefficient of imports of manufacturing products increased continuously, particularly after 1993, the coefficient of exports (exports as a proportion of domestic output) remained almost stagnant during the period 1993-95.

There has been a significant increase in **labour productivity** and in wages as well. As seen in Figure 2, the cost of labour per unit of output has increased 55 per cent between 1988-89 and 1995-6 . The increase results from the dramatic increase in the wage/exchange rate ratio after the introduction of the Real plan. Indeed, the wage/exchange rate ratio has grown much faster than labour productivity and, hence, the unit labour cost in the industrial sector has increased implying a significant reduction in the profitability and competitiveness of firms.

In the last few years, the total trade account went from an average surplus of approximately US$ 13 billion in the early 1990s to a deficit around US$ 5 billion in 1995 and 1996. Meanwhile, the trade account of the manufacturing sector, varied from a surplus of US$ 10 billions in 1990 to a deficit of US$ 1.5 billion in 1995. The most important changes took place in the capital goods sector , i.e. from a deficit of US$ 2.3 billion to a deficit of US$ 7.4 billion, followed by changes from a surplus of US$ 1.8 billion to a deficit of US$ 1.8 billion in the transport equipment sector and from a surplus of US$ 5.7 billion to a deficit of US$ 3.1 billion in the elaborated intermediary goods sector.

Figure 1. Import and export penetration in the manufacturing sector in Brazil

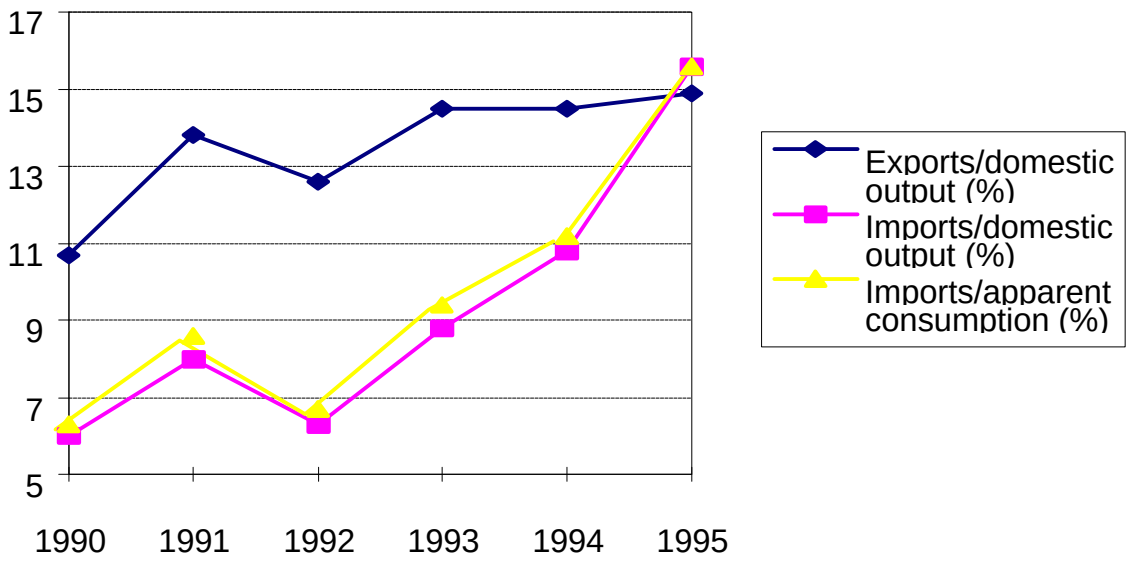
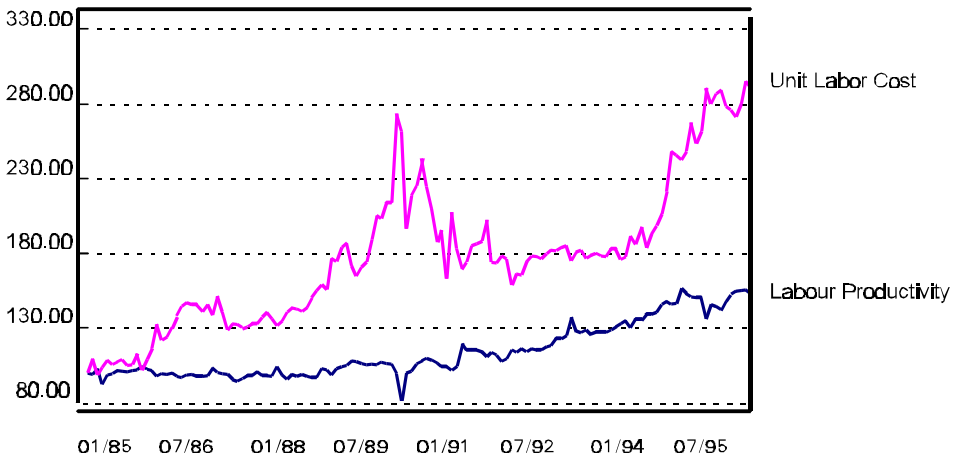


Figure 2. Labour productivity and unit labour cost



Import coefficients grew in all the manufacturing sectors but there are some sectors in which the increase was considerably greater than the average. As seen on Figure 3, the import coefficient (imports over domestic consumption) in the capital goods sector, where the impact was certainly greater, went from 20 per cent in 1990 to almost 60 per cent in 1995. The share of exports on domestic production grew from around 17 per cent in 1990 to slightly more than 40 per cent in 1995. As shown in Figure 4, in the electrical and communications equipment, the import coefficient went from 20 per cent in 1990 to almost 80 per cent in 1995 whereas in the machinery sector it varied between 23 per cent to almost 70 per cent respectively.

Figure 3: Import and export penetration in the capital goods sector

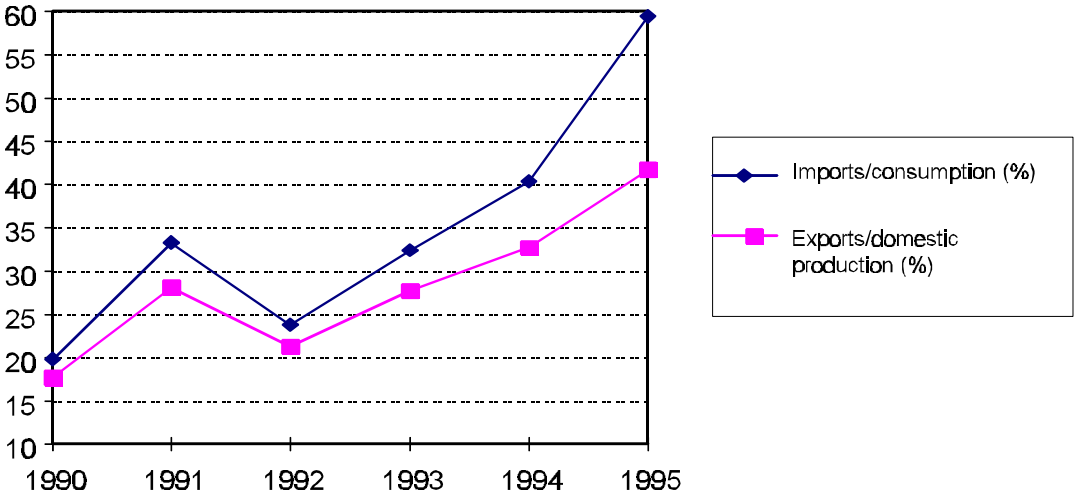


Figure 4: Star performers in import penetration (imports/domestic production, %)

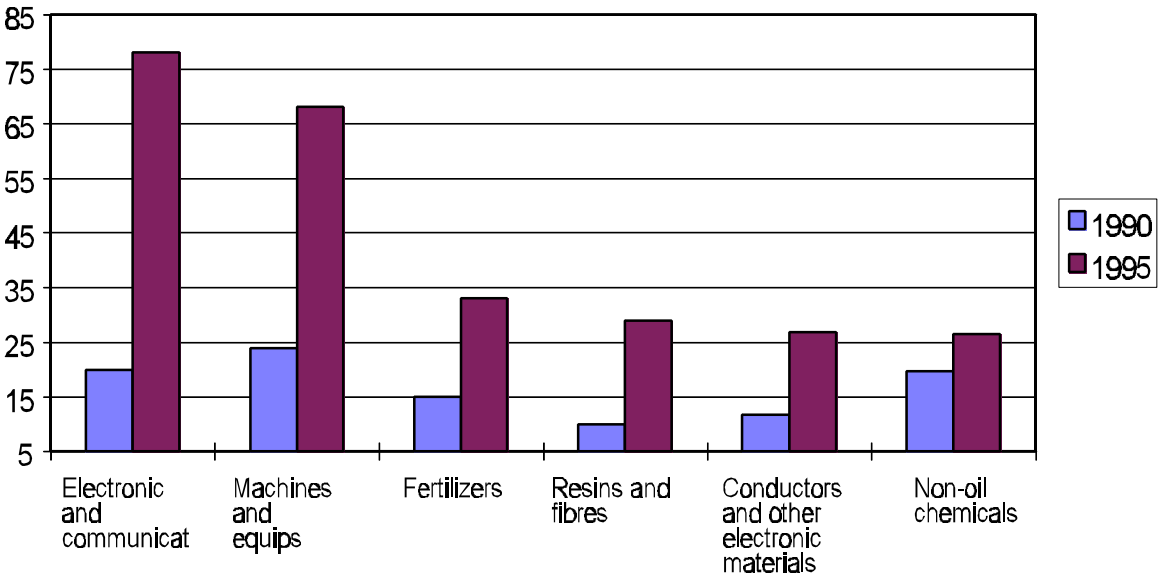
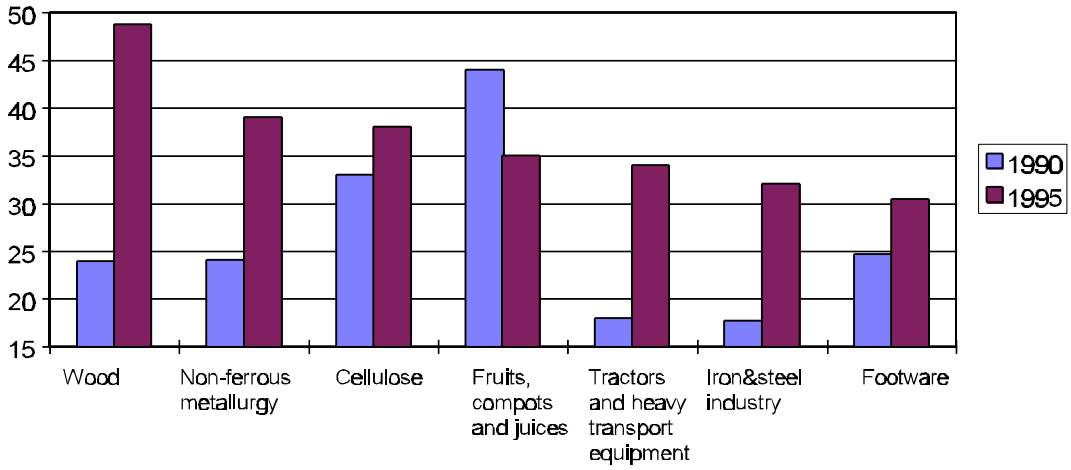


Figure 5: Star performers in export penetration (exports/domestic production, %)



There was also an increase in the **export coefficient** (exports over domestic production) in many sectors. As shown in Figure 5, the "winners" in this respect are products made of wood (an increase in the export coefficient from 25 per cent in 1990 to almost 50 per cent in 1995), metallurgy (from 25 per cent to almost 40 per cent), cellulose (from 33 per cent to 38 per cent), transport equipment (from 18 per cent to 34 per cent) and iron and steel industry (from 18 per cent to 32 per cent).

Summing up, the sectoral composition of imports and exports seems to have changed with a reduction in the comparative advantage of **sectors intensive in technology**, e.g. **machinery and electrical and communications equipment**, and an increase in the comparative advantage of **sectors intensive in natural resources** such as **wood, cellulose, metallurgy and iron and steel industry**. To a certain extent this is quite a reasonable change given that Brazil has abundant natural resources. Nevertheless, from a long term perspective and assuming that the growth of world market will continue biased towards technologically advanced sectors, this change in the pattern of trade can be a threat to the competitive integration of Brazil into the world economy.

In the Republic of Korea, on the contrary, the structure of **output and trade** by sectors has changed during the last two decades (1970-90) from one based on **food, textile and chemicals** to one based on **machinery, electronics and transport equipment**, i.e. from labour-intensive to capital and skill-intensive sectors. It should be noted, as in Table 2, that **the share of exporting[3] industries' output** to total manufacturing output has increased from 36.3 percent in 1970 to 47.2 percent in 1990 due to the performance of **exporting heavy-industries**. Although the output share of **exporting light industries** fell during this period, the share of the **exporting heavy-industries** grew from 14.7 percent in

[3]**Exporting industries** are those which rank high in the average export-ratio between 1970 and 1990. **Import competing industries** rank high in the average import ratio between 1970 and 1990. The remaining of the manufacturing sector was classified as the **domestically-oriented sector**. **Exporting industries** were also decomposed into exporting light-industries and exporting heavy-industries. The **main** products of the **exporting industries** are **textile and footwear** (light industries) and **automotive, shipbuilding and electronics** (heavy industries). These industries usually exported more than 30 percent of their outputs. **Import competing sectors** are mostly composed of capital goods producing industries. The imports took more than 40 percent of the total domestic demand in these sectors. **Domestically-oriented industries** are producing food, beverage, wood products, paper, nonmetallic mineral products, iron and steel (Cheon, 1997).

1970 to 33.3 percent in 1990. It is interesting to note that **import-competing industries** increased their output almost as fast as **exporting heavy-industries**. The annual growth rate of output (Table 3) between 1970 and 1990 was 21.8 percent in **exporting heavy-industries** and 21.1 percent in **import-competing industries**. It should also be observed that export growth in **import-competing industries** was higher than in any other industries. The annual growth rate of exports in **import-competing industries** was 29.4 percent and the share grew from 2.3 percent to 13.1 percent between 1970 and 1990. It was particularly high in the period of 1985 and 1990. This indicates that **import-competing industries** also increased their export performance during the last two decades.

Exporting heavy-industries also raised their share of **exports** from 11.3 percent in 1970 to 35.3 percent in 1990 with the annual growth rate of 25.5 percent. It can be argued that industries which were exposed to international competition **increased their output and exports** much faster than **domestically-oriented industries** with the exception of exporting light industries. In terms of imports, **import-competing industries** gained at the expense of **domestically-oriented industries**. However, the import share of **exporting industries** has increased, though at a smaller rate, from 24.4 percent in 1970 to 28.7 percent in 1990.

The **import-ratio**[4] of **steel** industry (KSIC 371) has decreased from 71.9 percent to 15.3 percent, and from 78.3 percent to 42.0 percent in the **machinery industry** (KSIC 382) in 1970 and 1990 respectively. **Basic metal** (KSIC 372) had a great portion of the imports in 1970, but the success of establishing the iron industry contributed to decreasing its imports since 1975 (Cheon, 1997). This implies that the **Korean economy has been successful in import substitution of heavy industry products such as basic metals (iron and steel) and machinery products as well as in their export promotion**. As argued by You (1984), these import-substituting industries have quickly moved to exporting industries during the two last decades. Therefore, import-substitution activities went along with the export-oriented policy stance. As remarked by Lim, Y (1995), "*export expansion and import substitution were not contradictory activities but were complementary to each other*" (p.5). The expansion of export production required a corresponding increased demand for imported intermediate inputs, parts and machines and, therefore, raised the import substitution possibilities for these export-related imports.

2.1 Impact on manufacturing employment

Employment growth pattern was very similar to that of output and export growth in both Brazil and the Republic of Korea. Table 2 shows that in the latter **exporting heavy-industries and import-competing industries increased their employment share** while **exporting light-industries** lost their share as well as the **domestically-oriented industries** during the period 1970-1990. The highest employment growth rate was observed in **exporting heavy-industries** (10.9 percent) and the lowest in exporting light industries (4.7). The latter had a negative growth rate during the period 1985-90. **Importing competing industries** contributed significantly to employment growth at the rate of 9.9 percent during the last two decades (Table 3).

It is possible to conclude that, firstly, the industries which have been exposed to foreign competition have increased their employment share most, except for exporting light-industries. Secondly, during the early phase of industrialization, employment growth was accomplished by prompting **exporting labour-intensive industries**, but in the latter phase

[4]Import ratio = Import/Total Demand (= Total Output-Export +Import).

of industrialization, the **skill-intensive industries** played an important role in raising employment. That is, **the exporting sector** has contributed to boost employment growth **by changing its output structure from labour-intensive products to technology and skill-intensive ones**.

Table 2. Share of output, export, import and employment by industry in the Republic of Korea (percentage, 1970-90)

Industry Groups classified by trade	1970	1975	1980	1985	1990
Output					
All manufacturing	100.0	100.0	100.0	100.0	100.0
exporting industries	36.3	40.6	39.4	43.1	47.2
light industries	*21.6*	*24.3*	*19.2*	*17.0*	*13.8*
heavy industries	*14.7*	*16.2*	*20.1*	*26.2*	*33.3*
import-competing industries	7.2	9.7	10.5	11.7	14.5
domestically-oriented industries	56.5	49.8	50.1	45.1	38.4
Export					
All manufacturing	100.0	100.0	100.0	100.0	100.0
exporting industries	69.6	70.0	72.9	75.3	70.6
light industries	*58.3*	*46.9*	*40.4*	*33.8*	*35.3*
heavy industries	*11.3*	*23.1*	*32.5*	*41.5*	*35.3*
import-competing industries	2.3	4.9	6.5	6.8	13.1
domestically-oriented industries	28.1	25.2	20.6	18.0	16.3
Import					
All manufacturing	100.0	100.0	100.0	100.0	100.0
exporting industries	24.4	39.3	31.3	33.3	28.7
light industries	*5.1*	*7.6*	*6.3*	*7.2*	*6.9*
heavy industries	*19.2*	*31.7*	*25.0*	*26.1*	*21.8*
import-competing industries	21.5	32.9	37.1	36.5	40.6
domestically-oriented industries	54.1	27.8	31.6	30.3	30.7
Employment					
All manufacturing	100.0	100.0	100.0	100.0	100.0
exporting industries	54.9	61.8	59.3	63.0	61.0
light industries	*37.4*	*40.0*	*31.6*	*32.2*	*24.8*
heavy industries	*17.4*	*21.8*	*27.7*	*30.8*	*36.2*
import-competing industries	6.5	7.6	11.7	9.2	11.4
domestically-oriented industries	38.7	30.5	29.0	27.7	27.

Source: Economic Planning Board, *Report on Mining and Manufacturing*, various issues, Seoul, Korea. Bank of Korea, *Input-Output Table*, various issues, Seoul, Korea.

Table 3: Annual growth rate of output, export, import and employment by industry in the Republic of Korea

Industry Groups	(1970-75)	(1975-80)	(1980-85)	(1985-90)	(1970-90)
Export					
All manufacturing	63.5	-0.4	6.7	13.7	18.6
exporting industries	63.7	0.4	7.4	12.3	18.7
light industries	*56.5*	*-3.3*	*3.0*	*14.7*	*15.6*
heavy industries	*88.4*	*6.7*	*12.0*	*10.1*	*25.5*
import-competing industries	90.2	5.5	7.6	29.6	29.4
domestically-oriented industries					
59.9 -4.3 3.9					
11.6 15.4					
Output					
All manufacturing	22.8	16.8	10.9	17.6	16.9
exporting industries	25.5	16.1	13.0	19.7	18.5
light industries	*25.7*	*11.4*	*8.2*	*12.9*	*14.3*
heavy industries	*25.2*	*22.0*	*16.9*	*23.4*	*21.8*
import-competing industries	30.3	18.7	13.4	22.6	21.1
domestically-oriented industries 19.7	16.9	8.6	13.8	14.7	
Import					
All manufacturing	36.7	-3.5	3.7	18.4	12.8
exporting industries	50.4	-7.8	4.9	15.0	13.7
light industries	*47.9*	*-7.1*	*6.4*	*17.6*	*14.5*
heavy industries	*51.0*	*-8.0*	*4.5*	*14.2*	*13.5*
import-competing industries	48.8	-1.2	3.3	21.0	16.4
domestically-oriented industries	19.7	-1.1	2.8	18.8	9.6
Employment					
All manufacturing	13.1	7.4	2.7	4.6	6.9
exporting industries	15.8	6.5	4.0	4.0	7.5
light industries	*14.6*	*2.5*	*3.1*	*0.7*	*4.7*
heavy industries	*18.3*	*12.7*	*4.9*	*8.1*	*10.9*
import-competing industries	16.9	17.0	-2.1	9.1	9.9
domestically-oriented industries	7.9	6.3	1.8	4.6	5.1

Source: Economic Planning Board, *Report on Mining and Manufacturing*, various issues, Seoul, Korea Bank of Korea, *Input-Output Table*, various issues, Seoul, Korea.

Note: all prices are adjusted to 1990 prices.

In the case of Brazil, changes in employment were decomposed in changes in domestic consumption, changes in the trade balance and labour productivity according to the following equations (Amadeo and Neri, 1998):

Eq. 1: $dP/P = dC/P + dX/P - dM/P$

Eq. 2: $dN/N = dP/P - dProd/Prod$

where :

- P = manufacturing production in US $;
- X = manufacturing exports in US$;
- M = manufacturing imports in US$;
- C = apparent consumption in US$ (proxy for domestic demand) defined as $C = P + M - X$;
- N = manufacturing employment
- Prod = labour productivity defined as P/N

According to Equation 1, changes in production (dP) can be decomposed into changes in apparent consumption (dC) and changes in the trade balance (dX-dM). Whereas dP, dC, dX and dM are changes in the respective variables between 1990 and 1995, dP/P, dC/P, dX/P and dM/P measure the rate of changes of P,C, X and M (in US$) with respect to the level of production in 1990. For example, dC/P says what would have been the increase (or decrease) in production as a result of the change in apparent consumption between 1990 and 1995 had the other variables (X and M) remained constant. A similar reasoning applies to dX/P and dM/P.

Equation 2 says that changes in employment can be decomposed into changes in output and changes in labour productivity. If output grows faster than productivity, employment increases, and vice-versa.

Table 4 shows the results of the decomposition exercise by sectors. It shows that employment fell 19 per cent on average and fell in **all** manufacturing sectors and labour productivity increased on average 30.7 per cent and increased in all manufacturing sectors. However, as seen in Table 5, employment fell more in the ***modern group***[5] (-28.3 per cent) than in the ***traditional group*** (-19.4 per cent). As a result, the share of employment in ***the modern sector*** has decreased from 56 per cent in 1990 to 53 per cent in 1996.

Table 4. Changes in manufacturing production, employment, domestic production and trade in Brazil (1990-95)

SECTOR	*dP/P*	*dN/N*	*dProd/Prod*	*dC/P*	*dX/P*	*dM/P*	*dX/P-dM/P*
Manufacturing	**11.00**	**-19.72**	**30.72**	**16.26**	**6.04**	**11.30**	**-5.26**
Natural resources							
Non metallic	4.09	-24.20	28.29	4.66	2.84	3.41	-0.57
Wood	23.91	-19.40	43.31	-11.19	36.53	1.43	35.10
Tobacco	6.27	-16.95	23.22	-5.40	13.08	1.41	11.67
Food	24.01	-17.72	41.73	20.34	10.52	6.86	3.67
Rubber	-8.92	-5.92	-3.00	-4.16	7.32	12.08	-4.76
Beverage	124.64	-14.32	138.96	129.49	2.09	6.94	-4.85
Unskilled labour							
Leather	-7.00	-15.20	8.20	-31.43	25.68	1.25	24.43

[5]The ***modern group*** corresponds to the capital and human capital intensive sectors whereas the ***traditional group*** corresponds to the combination of the unskilled labour and natural resources intensive sectors.

SECTOR	*dP/P*	*dN/N*	*dProd/Prod*	*dC/P*	*dX/P*	*dM/P*	*dX/P-dM/P*
Perfumery	39.09	-1.47	40.56	41.15	2.89	4.95	-2.06
Textiles	-24.22	-25.97	1.75	-16.59	1.25	8.88	-7.63
Clothing & Footwear	2.52	-32.02	34.54	3.66	7.14	8.28	-1.14
Capital intensive							
Furniture	45.34	-6.00	51.34	35.21	13.55	3.42	10.13
Paper	42.11	-23.35	65.46	33.63	16.35	7.88	8.47
Metallurgy	-8.28	-17.82	9.54	-9.61	5.31	3.98	1.33
Transport equipment	16.04	-7.60	23.64	30.75	3.66	18.37	-14.71
Editorial	55.24	-18.92	74.16	59.30	0.25	4.31	-4.06
Plastic	10.09	-17.83	27.92	14.81	1.41	6.12	-4.71
Human capital intensive							
Pharmaceutical	96.64	-2.54	99.18	106.07	1.73	11.15	-9.43
Chemical	0.45	-24.97	25.42	8.93	3.25	11.73	-8.47
Machinery	-13.84	-16.81	2.97	8.46	8.94	31.23	-22.30
Electrical equipment	6.95	-24.09	31.04	23.22	3.39	19.66	-16.26

Source: Szkurnik, I (1996)

Table 5. Evolution and sectoral structure of employment in the modern and traditional sectors in Brazil

Year	**Evolution of employment in manufacturing**		**Sectoral structure of employment**	
	Modern	**Traditional**	**Modern**	**Traditional**
89	100	100	0.56	0.44
90	98.05	97.50	0.56	0.44
91	90.42	91.53	0.56	0.44
92	75.46	78.91	0.55	0.45
93	73.49	81.37	0.53	0.47
94	74.8	85.54	0.53	0.47
95	76.73	83.14	0.54	0.46
	9671.7180.610.530.47			

Source: Amadeo and Neri (1998)

Trade liberalization and the opening of the economy has had an important influence on the behaviour of productivity. The opening itself has had a direct impact on employment since in most sectors the trade balance has gone from a surplus to a deficit. The negative impact on **employment** of changes in the trade balances and labour productivity were only partially compensated by the increase in domestic demand (or apparent consumption) as illustrated in Table 5. Moreover, these results corroborate the previous findings on trends in the trade pattern based on the analysis of changes in the import and export coefficients after trade liberalization. It shows, for instance, that **imports** (M), as a proportion of output in 1990, grew in all sectors between 1990 and 1995 but specially in the "**human capital intensive**" sectors, namely, **pharmaceutical, chemical, machinery and electrical equipment**. These are precisely the sectors in which the trade balance showed the most significant increases in trade deficits. If exports and apparent consumption had remained constant between 1990 and 1995, output in these sectors would have fallen between 8.43 per cent (chemical) and 22.3 per cent (machinery). **Exports (X),** as a proportion of output in 1990, grew specially in the "**natural resources", "unskilled labour and capital**

intensive sectors", particularly in **wood materials, furniture, paper, leather materials, tobacco and foodstuff**. These are the only sectors in which there was an improvement of the trade balance. **Apparent consumption (C)**, proxy for domestic demand, grew significantly in foodstuff, beverages, perfumery, furniture, paper, transport equipment, editorial, pharmaceutical and electrical equipment. Since Brazil was (and still is to a certain extent) a closed economy, the behaviour of **output (P)** was strongly influenced by the behaviour of apparent consumption. Changes in the trade balance did have an effect on production but these were certainly weaker then the impact of changes in apparent consumption.

We can see from the above evidence **changing patterns of comparative advantage** in the process of economic integration. In the Republic of Korea, comparative advantage has shifted towards high-technology intensive exports. In Brazil, on the contrary, during the post-liberalization period, there was a **decrease** in the comparative advantage of high-tech, skill intensive sectors, and **an increase** in the comparative advantage of low-skilled and natural-resources intensive sectors. This result is not surprising because an economy that has been closed for so many years is likely to behave as predicted by the traditional comparative advantage theories once it is open, i.e. sectors intensive in the country abundant resources, e.g. natural resources and unskilled labour, will show up. It raises, however, serious concerns in relation to the competitive insertion of Brazil in the international economy in the long run and especially assuming that the growth of the world market will continue to be based on the technology advanced sectors.

In the Republic of Korea the opposite trend has occurred but there the government policies have played an important role in promoting exports, prompting technological change and development of human resources. Government policies in Korea have "controlled" the degree of global competition through specific policies directed to promote exports, build up domestic industrial capacity and in-house developments, etc. In Brazil, there are no direct policies designed to foster skill-intensive sectors. Furthermore, the current "liberal vein" between policy-makers and government economists is that the opening of the economy by itself will bring greater productive efficiency, technological enhancement and economic growth. It is assumed that the import substitution strategy of the 1980s, which clearly was much more "active" in promoting the upgrading of the structure of manufacturing output and labour, led to the stagnation of productivity and the deterioration of welfare standards. According to this prevalent view, the integration of the Brazilian economy to the global market should be the basis for a new development strategy, implicitly repudiating the adoption of industrial policies.

3. Changes in the occupational structure and skill composition of labour

The skill level of the labour force in general has increased during the post-liberalization period in the countries surveyed as indicated by increases in the highest levels of educational attainment and corroborated by the growth rate of certain occupations such as managers, professionals, technicians and associated professionals. Similarly, in the **manufacturing sector**, there was a reduction in the proportion of production and related workers and an increase in the proportion of non-production workers.

In the case of the Republic of Korea, for instance, the **non-production workers' share of total manufacturing employment** has increased from about 15 percent in the

1970s to more than 30 per cent in the 1990s. From Table 6, the increase in **the share of non-production workers** was the result of increased demand for different occupations. The shift in demand towards **non-production workers** during the 1970-80 period corresponded to an augmentation of **clerical jobs**, probably promoted by the implementation of the investment programme on HCIs (1973-1981). As suggested by Cheon (1997), if there might have been a kind of ***'capital-skill complementarity***' in this period, it must have been ***'capital-clerical jobs complementarity"***. During the last decade, the rise in their share was principally due to an increase in the number of **scientists and engineers**. This increase may have been motivated by the technology-driven policies launched in the 1980s.

The sharp rise in **the non-production workers' employment share to total manufacturing employment** in the late 1980s reflects not only the industrial restructuring of manufacturing such as the waning of light industries and the advancement in factory automation but also changes in the labour market, e.g. wages rise of production workers, unskilled labour shortage and shifts in the balance of power between management and workers. *These structural changes were accompanied not only by an **absolute** decrease in production workers but also by a **relative** increase in demand for non-production workers*. Nonetheless, the **educational level** of production workers continued to improve over the 1980s although it increased less than the average.

Table 6.Changes in skill composition in the Korean manufacturing sector according to selected skill indexes

Skill Measure	1971	1976	1980	1985	1990
Occupational composition			**% workers**		
Professional and Technical Workers	4.1	1.9	2.0	4.0	5.2
- *Scientists and Engineers*	*3.6*	*1.5*	*1.5*	*3.5*	*4.4*
Administrative and Managerial Workers	0.5	3.3	2.7	2.6	3.9
Clerical and Related Workers	8.0	10.1	14.6	15.1	19.2
Sales and Service Workers	2.7	2.6	2.4	2.7	3.2
Production and related Workers	84.7	82.1	78.4	75.6	68.5
Total	100.0	100.0	100.0	100.0	100.0
Average educational attainment			**(% schooling years)**		
Non-production workers	11.4	12.4	12.5	12.8	13.1
Production Workers	8.3	8.4	8.6	9.6	10.2
All manufacturing workers 8.8 9.1	9.5	10.3	11.1		

Source: Ministry of Labour, *Occupational Wage Survey*, various micro data, Seoul, Korea.

A similar trend was also observed in Brazil. As noted in Table 7, there was an improvement of the **manufacturing sector's** skills in relation to the average between 1989 and 1996. **The reduction in the share of the two lower groups (zero to 4 years and 4 to 8 years) was greater than the average and the increase in the higher levels (8 years and**

more) was also greater than the average. In particular, there was a reduction in the share of the zero to 4 years group and a significant increase in the 8 to 12 years group. Similarly, between 1989 and 1996 and, in particular, during the sub-period 1993-96, there was a marginal improvement in the educational profile of the services sector in comparison with the average.

Table 7. The structure of employment by sector and skill in Brazil

Schooling	Services	Trade	Construction	Public sector	Mineral ext.	Manufacturing
			1989			
0-4 years	0.33	0.25	0.55	0.13	0.44	0.32
4-8 years	0.21	0.23	0.22	0.13	0.16	0.24
8-12 years	0.32	0.44	0.17	0.48	0.26	0.34
12 years +	0.14	0.08	0.07	0.25	0.14	0.12
			1993			
0-4 years	0.31	0.23	0.50	0.12	0.42	0.28
4-8 years	0.21	0.22	0.25	0.14	0.16	0.24
8-12 years	0.34	0.47	0.19	0.49	0.28	0.38
12 years +	0.14	0.08	0.07	0.25	0.14	0.10
			1996			
0-4 years	0.27	0.21	0.49	0.12	0.44	0.25
4-8 years	0.22	0.22	0.26	0.13	0.14	0.24
8-12 years	0.37	0.49	0.19	0.50	0.28	0.41
12 years +	0.15	0.09	0.06	0.25	0.14	0.11

Source: IBGE, *Monthly Employment Surveys*, National Institute of Geography and Statistic, Sao Paulo, Brasil.

Although there has been an upgrading of the skill content of the manufacturing labour force in both countries, there was also differences at **the sectoral level** that can be associated with trade and/or technology.

3.1 Changes in skill composition by industry

In Brazil, the evolution of employment and schooling in the manufacturing sector classified by factor intensity is presented in Table 8. In descending order of labour skill intensity the sectors are ranked as follows: human capital intensive, capital intensive, natural resources intensive and unskilled labour intensive[6]. The figures indicate that there has been a continued improvement of the skill content in all four groups. There was a decrease in the proportion of workers with zero years of schooling and between zero and 4 years of schooling in all the four sectors and in the manufacturing sector as a whole. As a

[6]**Unskilled labour intensive sectors** are the traditional manufacturing sectors, e.g. textiles, clothing and footwear, leather and perfumery, soaps and candle. **Natural resources intensive sectors** are also intensive in unskilled labour either at the extraction stage or at the processing stage. They comprise non-metallic minerals, wood, tobacco, foodstuff, rubber, and beverages. **Capital intensive sectors** have in common the fact that the process of production requires a high capital-output ratio. They include the following sectors: furniture, paper, metallurgy, transport equipment, editorial and plastics. **Human capital intensive sectors** are those in which value added is usually greater and rich countries specialise, namely, pharmaceutical, chemical, machinery and electrical equipment.

result, the overall manufacturing skill profile improved during the period 1989-1996. The proportion of workers with more than 8 years of schooling has improved in relation to the average skill profile of employed workers in the **human capital sectors**. This may be interpreted as an evidence that the demand for skills/education is greater than average in these sectors. The skill profile of **natural resource** sectors has also improved in the same categories but less than the average skill profile of the total employed population. *Ceteris paribus*, this may be an indication that the demand for skilled/more educated workers in this sector has been weak. The same conclusion can be applied in the unskilled labour sectors.

It should be noted that the skill content of the **to the capital and human capital intensive sectors** is greater than of the **unskilled and natural intensive sectors**. Therefore, the decrease in the share of employment in **the capital and human capital intensive sectors** could have led to a **deterioration** of the overall skill content of manufacturing employment had the intra-sectoral contents remained constant. In fact, however, the intra-sectoral content not only improved but improved sufficiently enough to more than compensate the impact of changes at the inter-sectoral level. That is, **there was an improvement in the overall skill content of the employed population in the manufacturing sector in spite of the change in the structure of employment in favour of the unskilled labour and the natural resources intensive sectors**. Moreover, as a result of the incipient trade liberalization process, it is precisely the latter that are expanding export performance. **Import coefficients** increased specially in the **human capital intensive sectors** whereas **export coefficients** increased in the **unskilled and natural intensive sectors**.

Table 8. Proportion of workers with different schooling levels in Brazil, 1989-96

Year	Human capital	Natural resource	Capital intensive	Unskilled labour	Total manufacturing	Total employed
Proportion of workers with zero years of schooling in each sector						
89	0.023	0.072	0.039	0.040	0.042	0.077
90	0.021	0.070	0.035	0.036	0.039	0.075
91	0.022	0.066	0.033	0.034	0.038	0.072
92	0.020	0.060	0.033	0.030	0.036	0.070
93	0.020	0.054	0.030	0.028	0.033	0.065
94	0.020	0.054	0.027	0.028	0.032	0.063
95	0.017	0.053	0.025	0.026	0.029	0.059
96	0.015	0.046	0.025	0.020	0.027	0.053
Proportion of workers with zero-4 years of schooling in each sector						
89	0.217	0.346	0.312	0.345	0.304	0.300
90	0.203	0.335	0.299	0.322	0.290	0.294
91	0.204	0.328	0.288	0.321	0.285	0.292
92	0.201	0.316	0.284	0.312	0.280	0.286
93	0.198	0.303	0.274	0.298	0.271	0.279
94	0.187	0.293	0.271	0.300	0.267	0.279
95	0.177	0.280	0.258	0.279	0.252	0.268
96	0.158	0.271	0.242	0.271	0.240	0.255
Proportion of workers with 4-8 years of schooling in each sector						
89	0.183	0.224	0.219	0.290	0.228	0.201
90	0.186	0.235	0.224	0.299	0.234	0.205
91	0.182	0.227	0.228	0.291	0.232	0.205
92	0.178	0.230	0.226	0.289	0.230	0.204
93	0.170	0.237	0.226	0.292	0.232	0.205
94	0.171	0.231	0.237	0.301	0.239	0.204
95	0.176	0.240	0.232	0.308	0.240	0.206
96	0.167	0.235	0.222	0.301	0.232	0.208
Proportion of workers with 8-12 years of schooling in each sector						
89	0.412	0.285	0.337	0.276	0.330	0.313
90	0.423	0.290	0.345	0.287	0.339	0.318
91	0.420	0.306	0.356	0.293	0.346	0.321
92	0.434	0.321	0.362	0.314	0.358	0.331
93	0.439	0.326	0.372	0.325	0.365	0.339
94	0.453	0.341	0.371	0.319	0.367	0.344
95	0.459	0.348	0.389	0.329	0.380	0.352
96	0.473	0.362	0.408	0.349	0.397	0.365
Proportion of workers with 12 + years of schooling in each sector						
89	0.166	0.072	0.093	0.049	0.096	0.109
90	0.167	0.070	0.096	0.056	0.098	0.108
91	0.171	0.073	0.095	0.061	0.099	0.110
92	0.167	0.074	0.095	0.056	0.097	0.110
93	0.173	0.079	0.098	0.057	0.099	0.113
94	0.169	0.081	0.094	0.051	0.095	0.110
95	0.172	0.079	0.096	0.057	0.098	0.115
96	0.186	0.086	0.103	0.058	0.104	0.119

Source: adapted from Amadeo and Neri, 1988.

In the Republic of Korea, the **exporting industries** are lower skill-intensive than **import-competing industries** (Table 9). In 1990, **the share of non-production workers to total employment** was 29.0 percent in import-competing industries, 28.3 percent in domestically-oriented industries, and 20.5 percent in exporting industries. **The skill upgrading rate, however, was faster in exporting industries**, particularly in the exporting light-industries. The annual growth rate of the share of non-production workers' employment was 3.49 percent in the latter and 2.75 percent in the exporting heavy industries. The rate fell to 2.72 percent in the import-competing sector and to 2.12 percent in domestically-oriented industries between 1970 and 1990.

Table 9. Employment share of non-production workers by industry in the Republic of Korea, (1970-90)

Share of Non-Production Workers in total manufacturing employment (%)					
Industry Groups	**1970**	**1975**	**1980**	**1985**	**1990**
All manufacturing	13.8	14.6	17.9	19.2	23.6
exporting industries	10.0	10.7	14.5	15.9	20.5
- light industries	*8.5*	*9.0*	*11.8*	*12.4*	*16.8*
- heavy industries	*13.4*	*13.8*	*17.6*	*19.6*	*23.0*
import-competing industries	16.9	18.1	22.8	24.4	29.0
domestically-oriented industries	18.6	21.7	22.9	25.0	28.3
annual growth rates					
Industry Groups	**(1970-75)**	**(1975-80)**	**(1980-85)**	**(1985-90)**	**(1970-90)**
All manufacturing	1.16	4.15	1.41	4.24	2.73
exporting industries	1.23	6.29	1.87	5.24	3.64
- light industries	*1.14*	*5.57*	*1.00*	*6.36*	*3.49*
- heavy industries	*0.59*	*4.98*	*2.17*	*3.31*	*2.75*
import-competing industries	1.28	4.74	1.44	3.46	2.72
domestically-oriented industries 3.16	1.11	1.72	2.53	2.12	

Source: adapted from Cheon, 1997.

This trend seems to be corroborated by the evidence provided by changes in the share of **scientists and engineers** (S&E) in manufacturing as shown in Table 10. The S&E share increased in the **exporting industries** principally in the late 1980s. In the **exporting heavy-industries**, it varied from 1.87 percent in 1976 to 2.56 percent in 1980 and then to 5.71 percent in 1985, reaching 6.85 percent in 1990. More significant changes were, however, observed in the **import-competing industries** where this indicator varied from 3.37 percent in 1980 to 9.04 percent in 1990. In the **domestically-oriented sectors**, the number of S&E has indeed declined in the late 1980s. This illustrates that the skill effects of technology-driven policies in the 1980s, the target of which was to improve international competitiveness of manufacturing, were relatively large in those industries exposed to global competition. The growth in the **years of schooling** of the labour force in all sectors reflects the policy's aim at extending higher education and developing R&D-related workforce.

Summing up, *in both cases*, skill upgrading in the manufacturing sector has happened in spite of changes in the structure of trade and employment due to, principally, an improvement in the overall skill content of the employed population. These country cases are very useful to illustrate that **government policies aiming at industrial restructuring to increase global competitiveness had different sectoral effects on the demand for skills**. In the case of the Republic of Korea, export promotion but also import substitution activities seem to have played an important role in upgrading the industrial and employment structures. The recent openness of the Brazilian economy has pulling higher the skill level of sectors facing increased competition from imports, i.e., the human capital intensive sectors.

Table 10. Skill composition by industry groups classified by trade in the Republic of Korea, (1976-90)

Industry Groups	1976	1980	1985	1990
share of scientists and engineers				
exporting industries	1.08	1.37	2.91	3.87
- *light industries*	*0.60*	*0.37*	*0.50*	*0.56*
- *heavy industries*	*1.87*	*2.56*	*5.71*	*6.85*
import-competing industries	3.42	3.37	7.42	9.04
domestically-oriented industries	2.32	1.72	3.63	3.60
years of education				
exporting industries	8.76	9.17	10.05	10.88
- *light industries*	*8.32*	*8.61*	*9.46*	*10.19*
- *heavy industries*	*9.47*	*9.84*	*10.73*	*11.45*
import-competing industries	10.30	10.29	11.16	11.86
domestically-oriented industries	9.79	9.96	10.71	11.27

Source: adapted from Cheon, 1997.

International trade can affect the overall skill composition by shifting demand for labour **between** industries. Nevertheless, it should be noted that the **intra-sectoral** skill content of labour has improved above the average in manufacturing to more than compensate for the (negative) impact at the **inter-sectoral** level. Considering that changes in the intra-sectoral skill profile of labour result from changes in technology and the organization of work which have an direct impact on the educational content of the labour force, these results seem to support the view that biased technological change play an important role in explaining changes in the skill profile of manufacturing employment. These observations, however, do not preclude the role played by increased foreign competition on within-industry skill upgrading.

The relationship between skill upgrading and exposure to global competition is, therefore, not simple and it is even more complicated to disentangle its effects from those caused by technological change. It is evident that skill upgrading has occurred in industries that are exposed to global competition, i.e. exporting industries and import-competing industries, even if it was not through a **direct** impact. Exports and imports can have

indirect effects on the skill level of manufacturing by acting as **intermediate vehicles** for technological upgrading and capital accumulation, especially in developing countries. Therefore, trade-versus-technology distinction is somewhat misleading in developing countries because trade is the vehicle through which new technologies can enter developing countries. Increased competition from international trade can stimulate rapid technological change and consequent changes in the production processes within industries which would affect the demand for labour according to **the stage of sectoral development**. This can be corroborated by the case of the Republic of Korea where the output structure has shifted from one based on labour-intensive light manufacturing products to technology- and skill-intensive sectors. Although skill upgrading has been remarkable in industries exposed to foreign competition, the share of non-production workers in exporting sectors is lower than in the import-competing sectors and even lower than in the domestically-oriented sectors. A possible explanation is that, even within outward-oriented, technology- intensive sectors, there are also activities that do not demand a very highly qualified work force. This is an important finding because it shows that for a country to integrate international markets in high value added activities it needs to cope, even in those outward-oriented sectors, with low technological activities. Therefore, in order to achieve a sustained development and international competitiveness a wide range of skills is needed. It is necessary to provide not only the most advanced technological capabilities but also some less sophisticated but complementary skills. Therefore, **skills need to be matched with patterns of sectoral development**. This makes a whole difference when policies are applied and designed to boost industrial competitiveness as we will see in the concluding section.

4. Conclusions and some policy implications

As we have seen from the above evidence, economic integration has been promoting changes in the patterns of comparative advantage and affecting the structure of production/trade and employment in the countries surveyed. In the Republic of Korea, comparative advantage
has shifted towards high-technology intensive exports whereas in Brazil the opening of the economy has favoured the export performance and, hence, output and employment growth of sectors that are based on natural resources and unskilled, labour-intensive activities. This trend in itself would have contributed to the deterioration of the skill level of overall manufacturing labour force. However, this has not happened and the skill level in manufacturing has, on the contrary, improved in relation to the skill profile of the overall employed population. In both cases, skill upgrading in the manufacturing sector has happened in spite of changes in the structure of trade and employment due to, principally, an improvement in the supply of labour in general. The skill level of labour has increased due to a better educational level of workers entering the labour market.

Unfortunately, there is no sufficient evidence to sustain the view that the openness of the economy has been promoting the demand for more skilled labour at least in countries at the early stages of trade liberalization. In these countries, as predicted by theory, the restructuring of industrial exports and employment has been in favour of low-skilled sectors. However, it should be noted that the skill level of exporting sectors has been upgraded relatively faster than that of other industries. What is happening in the LICs is that, in order to integrate foreign markets, their production is becoming more capital intensive. The sectors most exposed to foreign competition are those exporting labour-intensive products and importing skill-intensive or capital-intensive goods. Although

increase exposure to global markets can, though not directly, foster skill upgrading in manufacturing in the sense that trade promotes technology transfer and capital accumulation, it is clear that other factors play also an important role in explaining shifts in demand for labour in developing countries. It is expected, for instance, that skill intensity will increase with the size of establishments. Larger firms are in a better position to upgrade production with the introduction of modern technology and new methods of work organization, and support continuous worker training. To the extent that large firms with capacity to innovate and export are better situated in an open economy, then trade liberalization will shift resources towards these firms, leading to an increase in the demand for skilled labour. This suggests that in LICs, where the industrial sectors are characterized by an enormous heterogeneity at the plant level in terms of size, production technology and work organization, **within-industry heterogeneity across firms** may also be an important factor in explaining skill restructuring in the manufacturing sector.

In addition, considering the **within-industry idiosyncrasies** of the manufacturing sector in these countries, changes in trade policy do not appear to play a **major** role in explaining the observed changes in the skill profile of manufacturing. **Trade policies** are implemented across sectors and, therefore, do not directly address the intra-sectoral peculiarities. This indicates that policy intervention on firm-level learning is also needed. The challenge seems to be the creation of appropriate **incentives** to help individuals and firms within sectors to adjust to the demand posed on labour by increased international competition. Incentives to promote "networking" and the intrinsic horizontal and vertical interfirm linkages, would generate the necessary synergies for local development and skill upgrading. Moreover, these latecomers suffer from lack of backward and forward linkages with locals which may threaten their future competitiveness in the world economy. Local entrepreneurship should be rekindled, fostered and nurtured to further extend the frontiers of these economies. Tripartism and promotion of harmonious labour-management relations through information-sharing and joint-consultations with workers could help employers in the transition into borderless operations.

Moreover, both the country cases studied were useful to illustrate that **government policies aiming at industrial restructuring to increase global competitiveness had different sectoral effects on the demand for skills**. In the case of the Republic of Korea, export promotion but also import substitution activities seem to have played an important role in upgrading the industrial and employment structures. The policy's emphasis to developing vocational and technical skills for the newly emerging heavy and chemical industries (HCIs) in the 1970s shifted to expanding higher education due to the increased demand for high-skilled workers promoted by the technology drive policies in the 1980s. Thus, the increased number of high-skilled workers was the result of government policies towards human resource development and training to keep up with new technology and changing global conditions in a context of chronic labour shortage. The recent openness of the Brazilian economy has pulling higher the skill level of sectors facing increased competition from imports, i.e., the human capital intensive sectors. It is clear that the skill upgrading process needs to be followed by a coherent set of **human resource and trade policies** which are continuously adjusted to match the changing circumstances in the international scenario.

In view of the above, the dominant view that market forces will be sufficient to upgrade production and promote the country's insertion in a global economy in a better competitive position, needs to be taken with caution. As the case of the Republic of Korea shows, changes in their comparative advantage were the result of an orchestration of "liberal" but targeted-oriented policies accompanied by a huge government commitment to

and investment in upgrading the skill level of the labour market by importing talents and/or investing in their own nationals. Therefore, **domestic policies** that foster human capital accumulation are essential associates to more outward oriented trade policies. While external policies can open the door to expanded market opportunities, domestic policy reforms are needed to attract capital inflows and promote domestic efficiency and productivity growth. Without the domestic counterpart, trade liberalisation can lead simply to intensification of traditional comparative advantage and undermine the basis for sustainable development. Experience elsewhere has demonstrated policies that allow wages to adjust in line with export competitiveness and the support provided to higher technology industries on the basis of strict export performance requirements have facilitated the realisation of gains from trade expansion. These policies, however, have to be articulated at the intra-sectoral level considering the heterogeneity of manufacturing in LICs but also taking into consideration that labour conditions and, in particular, skills **need to be matched with patterns of sectoral development**. The demand for skilled labour will depend on the particular export role the industry/sector plays in the global commodity chains which will require, therefore, different levels of technological advancement and skills. As the country is moving/entering into the most difficult competitive areas of manufacturing where it is sheer technological and skill superiority, each has to keep improving its policies and the supporting skill and institutional base. The **educational and training system** have to be redesigned to meet the needs of most demanding exporting markets. This shows the importance and **complementarity of domestic economic and labour market policies to the nation's international competitiveness.** The challenge posed to LICs in the current context of trade liberalization is how domestic policies can best facilitate the realisation of gains from trade expansion. External and domestic policy coordination seems to be a necessary condition to benefit from the economic potential of more outward orientation. Therefore, the dilemma faced by these LICs in the current process of globalization and regionalisation continues to be anticipating and responding to the changing global economic situation both in terms of competitive threats and growth opportunities.

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